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OCTOBER 29, 1990

CADENCE SHOOTS FOR THE TOP

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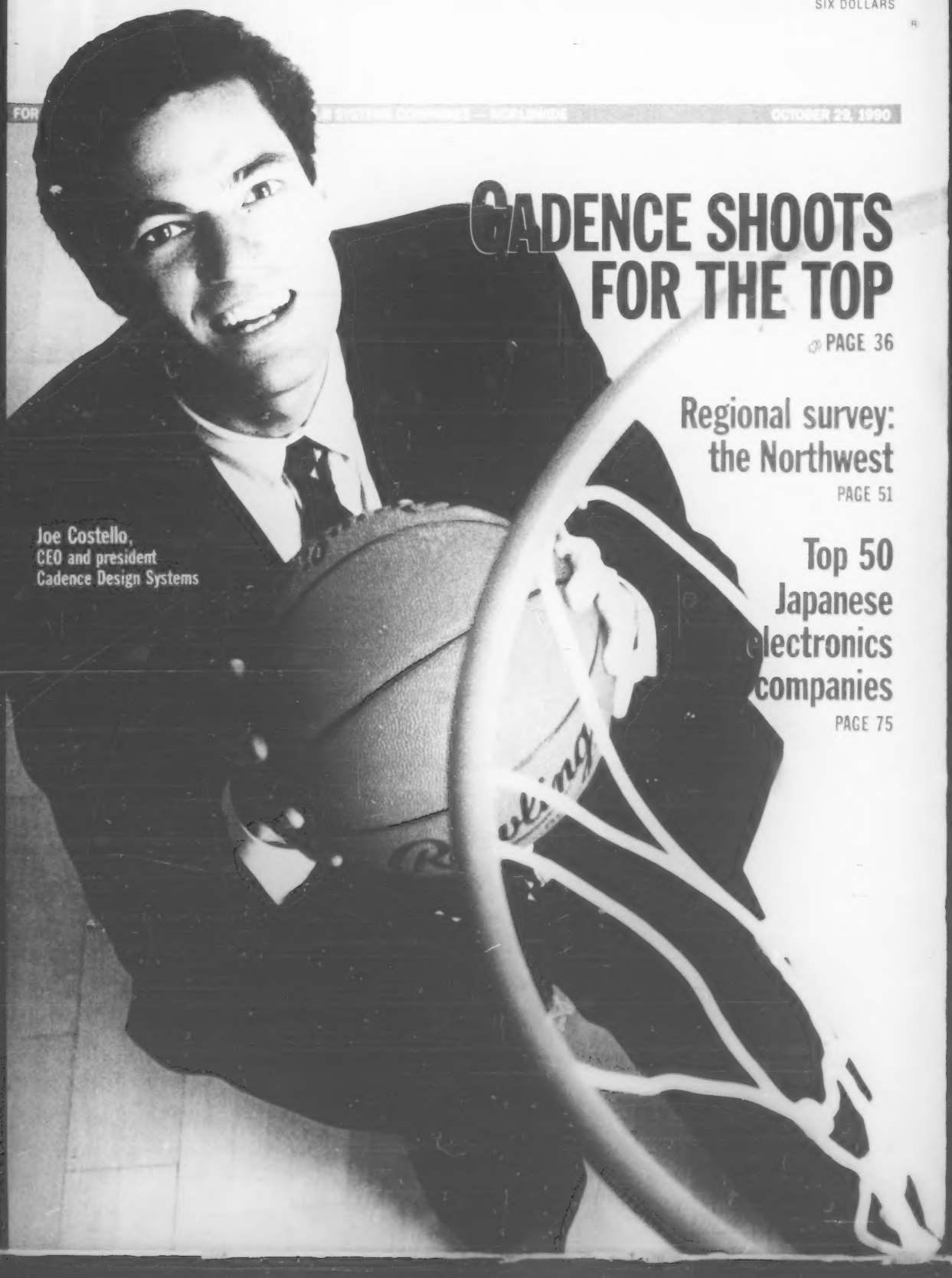

Joe Costello,
CEO and president
Cadence Design Systems

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES—WORLDWIDE

VOL. 16, NO. 20 OCTOBER 29, 1990

PAGE 36 Cadence will have to "slash and rip and tear our way to the top" to achieve its marketing goals during the '90s, says CEO Joe Costello

Cover: Christopher Springmann

Basketball facilities provided by the Decathlon Club, Santa Clara, CA

COVER STORY/CADENCE

36 Cadence shoots for the top

Cadence Design Systems is right on schedule in CEO Joe Costello's campaign to dominate the electronic design automation software market. But the going will get rougher now, as Costello and Cadence must compete in new markets to continue the company's phenomenal growth.

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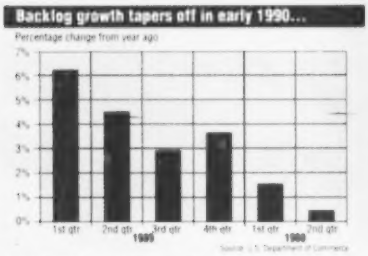

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Costello's hot hand

In basketball, there's a perception sometimes that a player acquires a "hot hand;" that is, his performance has been so extraordinary that the laws of probability shift in his favor, and a shot that ordinarily would bounce off the rim swishes through the hoop. Though statisticians debunk the hot-hand notion, most basketball pros believe it. They invariably pass the ball to the hot-handed player.

In the electronics game, too, everybody watches the player with the hot hand. How long can his shooting streak continue? Associate editor Peter Burrows has a play-by-play report in this issue on Cadence Design Systems, whose 6-foot-5-inch CEO Joseph Costello has made a series of three-point plays in the electronic design automation market. With 40% sales growth this year, Cadence holds second place among EDA software companies, and Costello is putting a full court press on market leader Mentor Graphics.

The company so far has been competing with chip-design companies. To maintain its sales growth, Cadence will have to compete in systems design as well, and that's a much rougher game.

As for Mentor, contributing editor Dwight Davis in Seattle reports that the Beaverton, Ore., company is just one of many electronics leaders to put down roots in the Pacific Northwest. The region has been outpacing the economic growth of the rest of the United States, and one big reason has been the proliferation of high-technology companies.

What brings these companies to the Northwest? Primarily the quality of life: clean air, available commercial property, and affordable housing.

From left to right: Matt Mulbry, production assistant; Christopher Springmann, photographer; Jill Meniketti, make-up; Joe Costello, Cadence's CEO; Michael Busselen, public relations for Cadence; and Mitchell Shenker, production assistant

But there are some drawbacks. The higher-education system is weak and there's a lack of support services, including venture capital. Analysts expect the Northwest's growth to continue and say its mix of technology companies, tourism, and agriculture may soften the boom-and-bust cycle that afflicts other regions.

From the Pacific Northwest, readers of this issue can look across the Pacific to the summit of the Japanese electronics industry. Senior editor Linda Stallman and contributing editor Paula Doe have expanded to 50 the number of companies tracked by ELECTRONIC BUSINESS in its annual report on the performance of the top Japanese electronics players.

JOHN W. PARKER, section editor

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VBPA ABP

Service involves everyone

I would like to offer some comments on your Aug. 6 "Viewpoint" column, wherein you stated that "Almost 80 percent of U.S. workers are employed in service activities . . . "

In reality, *all* U.S. workers are employed in service activities. While the words "product" and "service" are often used as near-antonyms, they are in fact synonyms. Both refer to that for which customers will part with their money.

Those who balk at being labeled members of a "service industry" should consider the end result for which their customers are paying. Customers have needs. Industries provide services. Sometimes customer solutions are produced by actions ("services"). At other times, customer needs are serviced by physical implements ("products"). In many cases, both actions and implements are required.

The common denominator is that industries exist to serve customer needs. In the final analysis, the customer seeks (and will pay for) a complete solution; whether that solution involves actions, implements, or both is of secondary importance. Companies which produce "products" and ignore "service" typically fail to adequately address the customer's needs, all the while wondering why their excellent products are not meeting sales expectations.

RICHARD L. HARTMAN
Manager
Engineering Project Administration
Output Technology Corporation

Goldstar headline

After reading "Ailing Goldstar needs strong medicine" in your Aug. 20 issue, especially the portion inside a box where I was directly quoted and my picture was shown, I could not but feel embarrassment. As a man who devoted his entire professional career to semiconductors and one who gave up a lot of his personal life to come back to Korea and work for Goldstar, I was embarrassed to have my name and picture with a headline " 'Biggest mistake' was semiconductors."

What disappointed me most was that a widely read and respected publication such as ELECTRONIC BUSINESS appeared to favor cheap sensationalism. I wonder what motivated the author to transform the caption "'Our biggest mistake' in semiconductors" as appeared in the May 1990 issue of *Electronics Business Asia*. Even I, whose mother tongue is not English, can see a huge difference between the implication of the two captions. It would not be too difficult for an average reader to see the obvious connection you intended to make between the front cover caption, "Lucky Goldstar's biggest mistake" and semiconductors.

It would appear to many of your readers, and to many of my colleagues in the semiconductor business, that I am admitting my past six and one-half years at Goldstar was a mistake in itself and a complete failure. On the contrary, I strongly feel proud of what was achieved despite a few "mistakes" we made along the way.

We are not ashamed of mistakes. Success does not teach us more than mistakes do. And we are still plowing through hard to achieve what was not done elsewhere in the industry. This was the spirit we conveyed during the interview on March 8 of this year.

CHANG SOO KIM
Vice President
Goldstar Electron
Seoul, Korea

EDITOR'S NOTE: Mr. Kim is absolutely correct to say that to replace the word "in" changes the meaning of the headline radically. Such an error should have been picked up when the pages were proofread for the final time. I thank him for pointing out the potential for error in our production system here at ELECTRONIC BUSINESS and offer sincere apologies.

His achievements for Goldstar Electron are considerable and I expect that Mr. Kim and his colleagues will continue to be successful in the semiconductor field, both in Korea and internationally.

Jeffrey Bairstow, Editor

Building partnerships

I write concerning the Aug. 6 My View column "The 23 of us."

We at UDS are not a $25 million company. We are a part of Motorola, but we don't act as though we have the total mass of Motorola when we partner with our vendors and customers. I think that you must remember that, regardless of your relationship with either, you must continue to be competitive and fair in your relationship.

Partnering does not mean taking each other for granted. In fact you must work harder, smarter, and closer for the relationship to go. Trust is also a critical path in the relationship. I know that this sounds like God, motherhood, and apple pie, and maybe it is; but it is my belief that if you don't build these partnering relationships, your long-term plan may not make it.

In conclusion, I buy into Ken Stork's comments.

GEORGE R. GRUMBLES
President
Universal Data Systems Inc.

Distributor tables

In your July 23 issue you presented a table listing the revenue per employee for six major industrial distributors. Please note that your reported figure of $192.1 thousand per employee, placing us last in your sample, is a gross error.

The Electronics Marketing Group of Wyle Laboratories posted revenue of $319 million through the efforts of 805 productive employees. This ranks us second in your sample, which has been our usual position among the major U.S. distributors.

RALPH L. OZORKIEWICZ
Wyle Laboratories

EDITOR'S NOTE: The figures for the table were obtained from Wyle Laboratories's annual report and 10K statement. It would seem that the breakdown of Wyle for the electronics marketing group, in terms of revenue and employees, was not available as audited figures. Therefore, to be consistent for each of the distributors listed, we quoted gross revenue and total employees.

I acknowledge that differences may occur when a company is organized into operating divisions. Thank you for bringing this matter to our attention.

Jeffrey Bairstow, Editor

Letters to the editor

ELECTRONIC BUSINESS welcomes letters to the editor on any topic of interest to our readers.

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CHINA

IBM reopens its business ties with People's Republic

IBM'S RECENT LAUNCH of its first joint venture in mainland China sends a strong signal that the U.S. electronics industry is ready to resume doing business with the People's Republic.

Tianjin Advanced Information Products Corporation (TAIPC), IBM's joint venture with Tianjin Zhonghua Electronic Computer Corp. (TZECC), will assemble the IBM PS/2 for distribution in the country through local dealers, according to Mac Jeffery, IBM's spokesperson for international business. IBM now has a total of 24 authorized dealers in China.

Big Blue has a long history of doing business in China. The company sold its first machine to China in 1934 and opened its first office in Shanghai two years later. Then, absent after 1949 for 30 years during the Mao era, IBM reentered the China market in 1979. Before last year's Tiananmen Square massacre in June, IBM had a 100-employee office in Beijing and a 2-person liaison office in Shanghai. IBM had to evacuate its 20 expatriates from China when the tanks were rolling in the streets. "By now, all the expatriates have returned to China," says Jeffery.

Initial negotiations on the formation of the joint venture actually began at the end of 1988. "The Chinese market represents a growing opportunity for IBM," says Robert M. Savage, managing director of Hong Kong-based IBM China/Hong Kong Corp. "This alliance with a Chinese partner will enable IBM to gain wider access and increase competitiveness in the marketplace."

The major advantage of assembling the computers in China is to avoid import tariffs. China's import tariffs on computers are much higher than on computer parts, and the rates vary from place to place in China. In general, the import tariff rates in coastal and "open" regions are much lower than inland areas. Open regions are government-approved industrial-development zones. The newly opened East Shanghai Economic Development Zone even enjoys a duty-free policy in order to attract foreign investments.

The coastal city of Tianjin, about 80 miles southeast of Beijing, is China's third largest industrial city, after Shanghai and Beijing. TZECC, IBM's partner, developed the country's first analog computer and first transistor computer. TAIPC will assemble most models of the IBM PS/2 family, including the PS/55, which runs on the Chinese language.

Besides being exempted from any import license requirements, IBM dealers in China will also benefit from shorter delivery cycles and the flexibility of selling in renminbi (RMB), the local currency. "This will provide the IBM dealers with a more competitive edge in the Chinese marketplace," says Savage.

China's shortage in hard currency has been the biggest concern of all for foreign companies doing business in China recently. The first question a foreign business negotiator would ask their Chinese counterpart is often an impolite one: "How much real money do you have?"

When asked what IBM will do with the RMB, Jeffery says IBM can use the local currency to cover some of the expenses of running the joint venture and to purchase products in China. He also points out IBM's international procurement office purchased more than $20 million worth of parts and components from suppliers in China in 1989 and exported them to IBM plants worldwide.

While refusing to reveal the size of the joint venture, Jeffery says it's a 50/50 capital investment between IBM and TZECC and will be staffed by about 20 Chinese engineers.

XIONG XIAOGE

IBM's Savage: looking to China to gain access

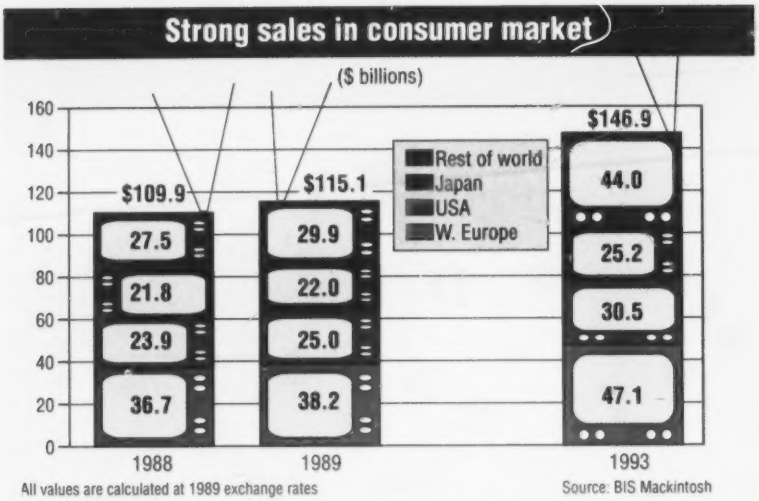
CONSUMER ELECTRONICS

Sales strong in consumer electronics

WHAT WAS BIG in consumer products in 1989? Compact discs and palm-size video recorders—and especially the market itself at $115.1 billion worldwide.

By comparison, total electronics sales in the United States totaled $295 billion in '89 and $425 billion worldwide. The consumer market's 4% growth came despite a general slowdown in the world economy, according to market researcher BIS Mackintosh, Luton, England. By 1993, BIS projects, the market will reach $146.9 billion.

According to BIS, Europe, the United States, and Japan represented most of the world's retail consumer sales dollars last year with 33%, 22%, and 19% of the market respectively. Sales into the "rest of the world" grew from 25% of the total market in 1988 to 26% in 1989.



Driving world-market growth are CD players, large-screen TVs, and video recorders. In Europe, color TVs remain the major purchases despite maturity of the market. BIS analyst Mike Brewerton says most Europeans are also replacing their old VCRs for smaller, higher-tech models, except in Spain and Italy, where growth is coming mostly from first-time buyers.

Japan, not unexpectedly, is buying up new products, including 30-inch-plus televisions. Super-VHS format VCRs reached 25% of retail sales, and video discs are becoming available for private use.

Surprisingly, though, the worldwide brand-name winners are not always Japanese, says Brewerton. Although Sony and Toshiba dominate in the United States, Europeans favor their national brands, such as SGS Thomson's RCA and Ferguson.

The United States is buying more large-screen color TVs, as well as more projection TVs. VCR sales are slowing, offset by healthy sales of compact camcorders. The compacts are beginning to erode the former dominance of full-size VHS, a trend BIS says is irreversible. Other areas to watch in the United States and Japanese markets, says Brewerton, include digital audio tape (DAT), which has just been released in the United States, as well as laser discs and interactive compact discs. Home theater, he adds, seems to be uniquely a U.S. taste.

Since trade barriers to the Eastern Bloc have been crumbling, there are consumer electronics manufacturers organizing joint ventures there. Hot items include VCRs and portable CD players, says Brewerton.

BARBARA JORGENSEN

AUTOMOTIVE ELECTRONICS

Japanese auto makers seek out foreign ICs

JAPANESE AUTOMOBILE manufacturers are finally becoming serious about using foreign semiconductors to provide competition in the home market and as locally procured components in overseas plants. Toyota Motor Corp., Japan's largest auto manufacturer, together with its major electronic equipment suppliers, has chosen five U.S. semiconductor manufacturers to join in the development of 23 items, including custom ICs and custom 8-bit microprocessors.

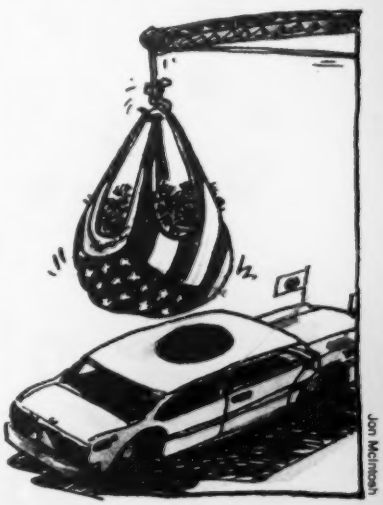
Selected manufacturers are Intel Corp., International Rectifier Corp., Motorola Inc., National Semiconductor Corp., and Texas Instruments Inc. Toyota says that the joint-development agreements could add $6.2 million to an earlier goal of $28 million worth of foreign-made semiconductor purchases in fiscal 1992.

The 23 items slated for joint development include custom ICs such as power integrated circuits for suspension control, standard-cell ICs for body control, interface ICs and AC/DC converters for engine control, ICs for meter clusters, and Dolby ICs for audio systems. General-purpose 8-bit microcomputers will be partially customized for use in transmission control, electronic meters, air conditioners, and other functions.

The number two Japanese car maker, Nissan Motor Co., is also on the move. A team of design engineers from Nissan and some affiliated equipment suppliers visited four European and three U.S. semiconductor companies in September. For the European leg, they were joined by engineers from Nissan European Technology Centre in Sunderland, England.

Tsuneomi Yano, senior manager of Nissan's electronics design department and head of the team, says: "We are confident that our team will play a significant role in increasing our local procurement and in developing a medium- and long-term relationship with leading manufacturers overseas." The companies that his team visited in Europe are N.V. Philips in the Netherlands; SGS-Thomson Microelectronics (SPA) in Italy; and Telefunken Electronic GmbH (AEG Group) and Siemens AG in Germany. The U.S. companies visited were General Instrument Corp., Harris Semiconductor Inc., and Signetex, Inc.

Meanwhile Nissan is working toward adoption of general-purpose and jointly developed chips from the six U.S. manufacturers it visited last



CAPITAL SPENDING SURVEY

Electronics CFOs report slowing capital spending

CAPITAL SPENDING IN THE U.S. electronics industry slowed during the second quarter of 1990 and is expected to slow further in the third quarter to show a decline for the year, according to a quarterly survey conducted by ELECTRONIC BUSINESS. The reason for the slowdown is largely a result of slowing sales and a growing pessimism about the economy.

In a poll of 91 chief financial officers, 38% say they plan to spend less in 1990 than they did in 1989 while 34% claim they will spend more. The remaining 28% say they will spend about the same amount. However, the spending slowdown is more serious than the aggregate figures indicate: Fifty-two percent of the polled companies with sales of more than $100 million say they expect their capital spending in 1990 to drop. It is these larger companies that account for the bulk of the industry's capital formation.

For the third quarter of 1990, capital spending plans were forecast to be lower at 41% of the companies surveyed, higher at 34%, and about the same at 25% of the companies, compared with the third quarter of 1989. Third-quarter spending plans were also down compared with those for the second quarter: 43% of the respondents said they would spend less in the third quarter than in the previous quarter, 32% planned to spend more, and 25% claimed to be spending about the same amount.

Actual spending in the second quarter of 1990 was markedly lower than had been expected three months earlier. A total of 46% of all respondents spent less in the second quarter than in the second quarter a year ago. However, only 33% had *planned* to spend less, according to first-quarter survey results.

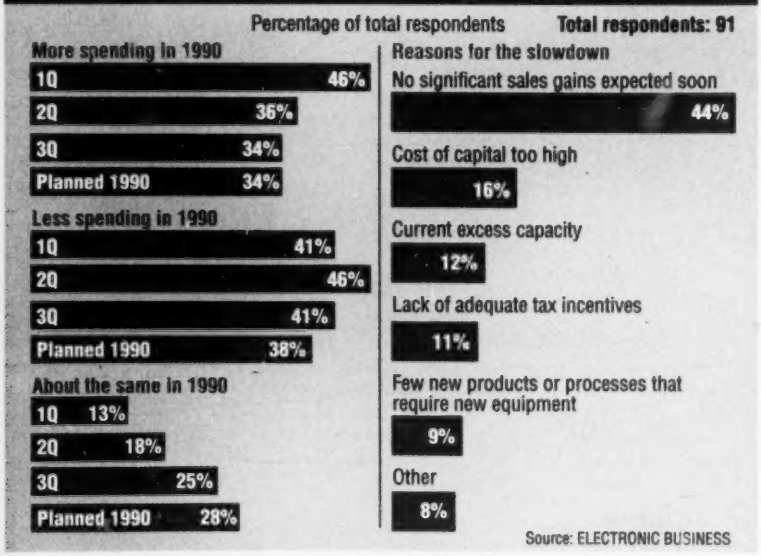
During the second quarter, the average capital spending outlay for the companies polled was about $460,000. This was double the average outlay for the previous quarter. Fifty percent of the capital spending went to factory capital equipment, 30% to office capital, and the remainder to bricks and mortar and other items. A full 89% of companies polled spent their money in the United States.

The most common explanation for the slowdown, given by 44% of the respondents to the second-quarter survey, was that no sales gains were expected soon. Running a distant second with 16% of the votes was the high cost of capital. Other reasons included excess capacity, inadequate tax incentives, and low profits and cash conservation.

The turnaround in spending plans can also be put down to a growing pessimism about the U.S. economy. "There is clearly a problem with profits, and most businesses are seeing their worst sales growth for quite some time," says Elizabeth Baatz, a Cahners economist. "I expect capital spending to continue to be weak in the fourth quarter, but I expect it will pick up in 1991 as the general economy and the electronics industry rebound," she says.

BRUCE C.P. RAYNER & XIONG XIAOGE

Growing pessimism over capital spending



This survey is conducted on a quarterly basis by ELECTRONIC BUSINESS. Participating companies come from all sectors of the electronics industry and range in size from $2 million to $2 billion. For more information on survey results, contact Bruce Rayner at (617) 558-4736

DEMOGRAPHICS

Lawyers versus Engineers

IT CAN BE ARGUED that some members of society, namely engineers, contribute to real GNP growth; others, namely lawyers, don't. In the United States, the contributors are losing out to the non-contributors.

Today, the United States averages one lawyer to every two engineers, according to demographic data compiled by AUS Consultants, an industry research firm in Conshohocken, Pa. Not surprisingly, the highest ratio of lawyers to engineers—at 5.5 to 1—is in the District of Columbia. All is not lost, though. In California, the ratio is a more comfortable 0.37 lawyer to every engineer. In Massachusetts the ratio is 0.46 to 1.

Don't get complacent, though. By the year 2000, the overall U.S. ratio will be 1.2 lawyers to every engineer, according to AUS.

BRUCE C.P. RAYNER

Electronics community flourishes in the Northwest

Region's infrastructure and higher education are weak, but low costs and quality of life nourish high-tech growth

BY DWIGHT B. DAVIS

Mention the Pacific Northwest, and people usually envision snow-capped mountains, rugged coastlines, dense forests, and endangered spotted owls. While such images are accurate, the picture they evoke is incomplete.

For several years now, the Northwest states have been surpassing the rest of the country's economic growth. Idaho, Washington, and Oregon ranked second, fourth, and sixth in the nation, respectively, in increased employment for the 12 months ending May 31, 1990, says John Mitchell, senior vice president and chief economist at U.S. Bancorp in Portland, Ore.

Dominating the region's manufacturing employment picture is Seattle-based Boeing Co., which has paced Washington's industrial expansion during the past several years (see "As Boeing goes, so goes Washington"). Still, the region's expansion has come in no small part from a proliferating base of diverse high-technology companies. Washington alone hosts more than 800 electronics companies and more than 500 software operations, according to the American Electronics Association.

Electronics companies have set up shop throughout the three states, with pockets of high-tech activity located in cities such as Spokane, Wash., Eugene, Ore., and Boise, Idaho. But the twin hubs of Seattle and Portland account for the vast majority of the region's electronics sites and employment.

Both of these booming metropolitan areas have capitalized on the Northwest's vaunted quality of life to lure high-tech investment and professionals and to keep the local talent from straying. Despite shortcomings in the states' higher-education systems, rising real estate costs, and growing concerns of overdevelopment, Seattle and Portland continue to be popular cities for electronics industry expansion.

Building an infrastructure

The industry's infatuation with the Northwest didn't happen overnight (See "Pioneering the Northwest"), and putting operations in the region still has some drawbacks. Although Seattle and Portland both boast services such as venture capital firms, industry lawyers, and component suppliers, the Northwest's electronics infrastructure can't yet compare with that of the San Francisco Bay Area, says Cyrus Tsui, president and CEO of Lattice Semiconductor Corp., based in Hillsboro, Ore.

"In the Bay Area, there are many small companies with different kinds of expertise to support our industry," he says. "Consequently, we still need to access the Bay Area for services such as testing and packaging our products.

"Still, the infrastructure limits here aren't crippling," Tsui continues, "and they are balanced by Portland's quality of life, its lack of pollution and congestion, and its plentiful, inexpensive housing."

How long can the area retain its attractions in the face of its booming growth? It remains an open question. Long time Seattle residents are bemoaning the bumper-to-bumper traffic that now clogs the city's highways and the property values that grew more than 25% during the past year.

The influx of new residents and companies has brought the long-simmering sentiment, which opposed growth and development, to the boil in both Seattle and Portland. In Portland, this response is manifesting itself as resistance to a proposed highway that would serve the high-tech "Sunset Corridor" on Portland's western fringe.

For the most part, though, the electronics industry is viewed as a good neighbor. And many electronics executives actually value the presence of the anti-development factions.

"As an industry, we need to make certain that we deal with growth issues better than we have in the past," says Thomas Brug-

Northwest electronics and software industries

	Washington (1989)	Oregon (1988)	Idaho (1989)
Companies	1,300	400	278
Employees	43,300	31,000	31,666
Total Payroll	$1.59 billion	$900 million	$678 million
Average Salary	$36,950	$29,000	$21,400

Sources: American Electronics Association, Washington and Oregon councils; Idaho Department of Employment

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Electronics in Washington

Total number of companies:	800
Total number of employees:	36,000
Average salary:	$35,000
Total industry payroll in state:	$1,260 million
Total value of electronics goods and services produced in Washington:	$3,816 million

Source: American Electronics Association, Washington Council

Software in Washington

Total number of companies (includes sole proprietors operating on either a full- or part-time basis):	500+
Total number of employees:	7,300
Average salary:	$45,039
Total industry payroll in state:	$328.8 million

Source: American Electronics Association, Washington Council

gere, chairman and CEO at Mentor Graphics, based in Beaverton, Ore. "We don't want to pave over the Sunset Corridor like we did Silicon Valley."

Far East access

Another attraction Portland and Seattle share is their geographic access to the markets of Asia. With these markets growing in importance to many electronics companies, the two cities have been pushing their strengths as gateways to the East. Each city's airport offers direct flights to Japan, and because of time zones, the Asian countries can also be reached by telephone the same business day.

Both cities' ports are also booming, but ocean shipping plays a small role in the distribution networks of most electronics and software companies. "We can put a month's worth of production in the trunk of a car," jokes Kipp Bedard, vice president and manager of investor relations at Micron Technology. The ease of chip distribution is part of the reason that Micron is able to exist in the relative isolation of Boise, he says.

For its part, Oregon has viewed Asian access as a two-way street. The state has successfully lured a number of Japanese companies to the Portland area. Key to Oregon's success was the repeal in 1984 of its unitary tax, which tapped the worldwide revenue of foreign companies operating within the state, rather than only the revenue generated by the in-state operations of those companies. California and other states eventually dropped their unitary taxes, but not before several foreign companies had chosen Oregon as a place to establish a U.S. presence, says Steve Petersen, deputy director of the Oregon Economic Development Department.

To boost the supply of trained workers, electronics companies are investing in the region's system of higher education

Among others, NEC America, Seiko-Epson, Fujitsu America, and Oki Semiconductor have set up Portland-area operations. Scott Gibson, president of Beaverton-based Sequent Computer Systems Inc., estimates Japanese companies employ about 5,000 people in the state.

Education a weakness

Electronics executives may debate some pros and cons of doing business in the Northwest, but on one subject there is unanimity: The region's educational institutions are a weak point compared with high-tech powerhouses such as the Massachusetts Institute of Technology in Cambridge, Mass., and Stanford University in Palo Alto, Calif.

In Seattle, the University of Washington's computer science and engineering department is well regarded, but it produces only about 120 graduates each year. That is far below the needs of just one key high-tech em-

As Boeing goes, so goes Washington

Despite its diverse electronics and software base, Washington is still largely dependent upon the fortunes of Seattle-based Boeing Co., which is flying high at the moment with a multibillion-dollar backlog of orders. With more than 100,000 employees, the aircraft manufacturer dwarfs all other manufacturing operations in the state.

By comparison, Washington's 800-plus electronics companies employ 36,000 people (including about 6,000 from Boeing's Electronics Division, or 17% of the total), and the 500-plus software companies employ only about 7,300 personnel, reports the Washington Council of the American Electronics Association.

An independent report commissioned by Boeing and released one year ago confirmed the company's dominant role in shaping the state's economy. The report's authors calculated that Boeing directly or indirectly supported almost one out of every six jobs in the state and that it accounted for 18% of the 1989 gross state product in Washington.

In addition, the company lead the state's expansion during the past decade, and accounted to some degree for 37% of the 500,000 new jobs and 43% of the $11.5 billion in personal income added from 1983 to 1989.

"Despite the state's industrial diversification, its dependence on Boeing hasn't decreased very much," concludes Douglas H. Pedersen, a co-author of the Boeing study and vice president and economist at the Security Pacific Bank of Washington. □

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Pioneering the Northwest

Two test-and-measurement companies were among the Northwest's electronics pioneers. The first, Tektronix Inc., was founded in Portland in 1946 by two Oregonians, Howard Vollum and Jack Murdock. Six years later, John M. Fluke Sr. moved his namesake company, John Fluke Manufacturing Co., and its three employees from Connecticut to his native Washington state.

Both companies faced similar obstacles due to their isolation from the nation's main electronics centers, and these obstacles in turn helped shape each company. "There was no local infrastructure to support us, and that put a high premium on the resourcefulness of the company," says John M. Fluke Jr., chairman of the Everett, Wash. company that now employs about 1,700 people in the region.

With no local suppliers, both Fluke and Tektronix built many of the parts for their systems internally, becoming highly vertical manufacturing operations in the process. And although each company since has come to rely more upon outside suppliers, both still make many of their critical components in house.

Through the 1950s and 1960s, the Northwest's high-tech industry remained a quirky mix of a few companies, almost all established by local founders who preferred to stay home. It wasn't until the mid-to late-1970s that out-of-state corporations—notably Hewlett-Packard Co. and Intel Corp.—began to move operations to the region.

Those two California companies were finding it tough to expand in the crowded and increasingly expensive Silicon Valley. Intel, in searching for a wafer fabrication site, looked for a spot with abundant water and power that was within a two-hour plane flight from its Santa Clara headquarters, says John Calhoun, director of administration for the Intel Systems Group. Beaverton, Ore., fit the bill, and Intel made its first move north in 1976.

A year earlier, when Bill Gates founded Microsoft Inc. in Redmond, Wash., no one could have imagined the role the company would come to play in setting trends in personal-computing software. Microsoft surpassed $1 billion in sales in fiscal 1990 and employs more than 3,000 people in Washington. Microsoft plans to add another 1,000 employees to its Washington work force by next July, says technical recruiting manager Julie Walker.

Spinoffs make good

By the early 1980s, the growing electronics community began to spin off a significant number of new companies. Among them were two Beaverton companies: Mentor Graphics Corp., founded in 1981 by a group from Tektronix, and Sequent Computer Systems Inc., established in 1983 by two Intel general managers.

Thomas Bruggere, Mentor's chairman and CEO, remembers that the region was still considered the outback by some quarters in 1981. "The venture capitalists tried to talk us into moving to Silicon Valley," he says.

Bruggere and his partners resisted, and Mentor became the first company in the area to receive a sizable venture investment—about $9 million over three rounds. Still, being a new company in the Northwest had its drawbacks, Bruggere recalls.

"It was tough to find lawyers, bankers, and accountants who understood the needs of high-tech start-ups," he says. With fiscal 1989 sales of $426 million and 1,500 of its 2,700 employees based in Oregon, Mentor clearly managed to overcome those obstacles.

So did Sequent, which expects to realize sales of about $245 million this year, according to president Scott Gibson. Today, according to Gibson, most of the infrastructure weaknesses of the region have been addressed. "The local banks are pro business," he says, "and there is a good entrepreneurial business climate." □

ployer, software giant Microsoft Inc., based in Redmond, Wash. The state's university system is stymied by a funding formula that requires any expansion of the engineering program to be balanced by cuts in other departments, says Terry Byington, executive director of the AEA's Washington council.

Both Washington and Oregon also suffer from a fragmentation of university engineering programs among several state and private universities. In Oregon, that has meant that no single institution has been able to become a world-class engineering and technical center, says Kyle Ritchey-Noll, Byington's Oregon AEA counterpart.

To address this problem, Oregon's AEA council and electronics companies are pushing for the establishment of the "Oregon Joint Graduate Schools of Engineering" in the Portland area. The joint institution, as envisioned by a higher-education committee studying the matter, would combine the resources of Oregon State University, the University of Oregon, Portland State University, and the Oregon Graduate Institute of Science and Technology.

"Our goal is to develop a graduate engineering and research program that will be among the top 10 to 15% in the nation within the next 15 years," says Ritchey-Noll.

The electronics industry has done more than lobby for higher-education improvements in the Northwest; it has also provided funding and staff support for the effort. AEA-member companies contributed $1.5 million in the mid-1980s to help fund the Oregon Consortium on High Technology Education, credited with reversing the decline in quality of the state's post-secondary schools. And in Everett, Wash., the John Fluke Manufacturing Co. contributed $5 million for research scholarships at the Washington Technology Center.

Most industry executives acknowledge that even with their support, it will be tough to develop teaching centers that match the engineering programs of an MIT or a Stanford. But even in their absence, companies such as Microsoft have no trouble drawing top-notch personnel to the

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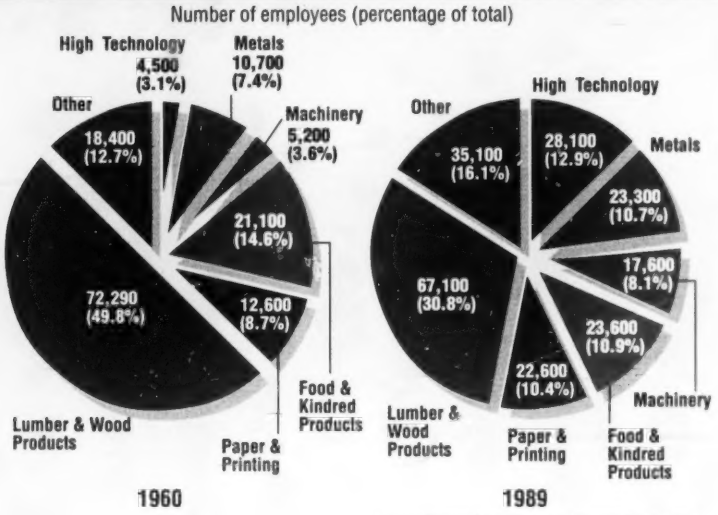
Change in Oregon's manufacturing employment



Source: Oregon Economic Development Department

area, says Julie Walker, Microsoft's technical recruiting manager.

"But smaller companies that lack Microsoft's resources can't always afford to mount nationwide recruitment efforts," she adds. "Those companies, as well as Microsoft, would love for the local schools to produce more people."

Bucking national trends

The continuing electronics and software industry expansion in the Northwest suggests that the region may be more recession-proof than most. With the electronics base diversifying the states' employment picture beyond the timber, agriculture, and tourism industries, Washington and Oregon shouldn't suffer as badly as they did in the recession from 1979 to 1982, many economists say.

The broader mix of industries will help both states, agrees U.S. Bancorp economist Mitchell, but he cautions that the region is still vulnerable to external factors, such as Iraq's invasion of Kuwait as well as the resulting inflationary pressures caused by rising oil prices.

If the United States slides into a broad recession, housing starts will decline and the region's timber industry will suffer. Higher gas prices will hurt both tourism and agriculture, Mitchell warns.

No guarantees

While the electronics industry in Washington and Oregon can't yet guarantee prosperity for the Northwest, it has still gone a long way toward establishing its own security there. The broadening number and type of companies populating the Northwest's landscape are helping the region's electronics sector to become more self-sustaining and self-reliant.

Evidence of this shift is Portland's ability to take significant layoffs at Tektronix Inc. in stride. At the end of August, the company's work force had dropped to about 13,000, down from 15,708 in May 1989. Some of those employees who were let go left under retirement packages, but many others were picked up by other high-tech companies in the area. In years past, many of those laid off would have been forced to look for work in other states.

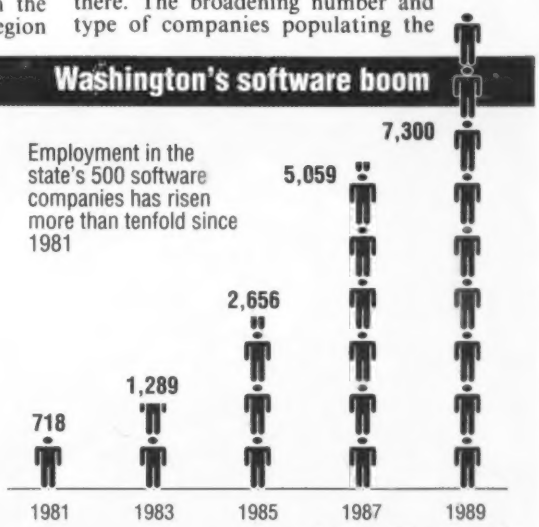
The increase in employment options has eased the concerns of workers relocating to Portland and Seattle, companies report. "In the past it was harder to attract people to the area, because if things didn't work out, they had nowhere else to go," says Fletcher Chamberlin, investor relations manager and corporate communications director at Tektronix.

Once workers do relocate to the Northwest, most choose to stay. And, according to electronics executives in the region, their employees are better workers and more loyal than their counterparts in many other areas of the nation.

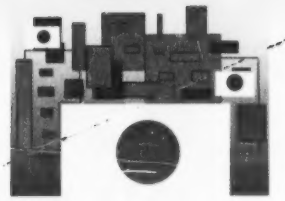
AEA figures indicate that employee turnover in Washington and Oregon is on the order of 19% per year, compared with a national average of about 16% in the electronics industry. But companies in the area claim that turnover rates are much lower in the Northwest region than in their facilities in California and elsewhere. Some speculate that the Tektronix layoffs may have inflated the AEA's turnover figures, at least for Oregon.

Mentor Graphic's Oregon attrition rate (voluntary and involuntary) is about 5%, compared with a 10% rate in the company's California operations, according to Bruggere. "And the work ethic is better in the Northwest," he remarks. "It's not like Silicon Valley, where, if this is Tuesday, it must be time to change jobs." □

Washington's software boom



Source: Washington Software Association



Japan's top 50 companies turn in a strong performance

But gains in revenue per employee by U.S. companies mean Japan is losing its productivity edge

BY PAULA DOE

Despite a weakening yen, the leading Japanese electronics companies managed to post solid revenue and net-income growth last year. But growth in productivity at top U.S. electronics companies is eroding Japan's productivity edge.

Because the yen's value in March —158 yen to $1—was nearly 20% less than it had been a year earlier, most Japanese companies saw revenue in dollars decline for the fiscal year. The ELECTRONIC BUSINESS list of the leading 50 Japanese electronics companies shows their combined electronics sales at $220.1 billion for the fiscal year ending March 31, compared with a $277.1 billion total for the top 50 U.S. companies for calendar year 1989.

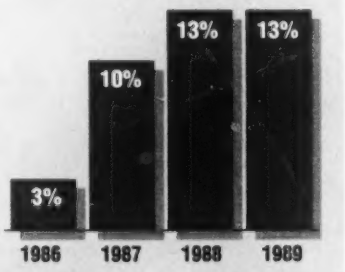
The ELECTRONIC BUSINESS listing shows 37 of the top 50 Japanese electronics companies each posted electronics revenue of $1 billion or more for the fiscal year ending March 31. Hottest growth for the top 50 came from the consumer-electronics sector, primarily from the large exporters: Nintendo Co. Ltd. (#22) saw a 43% increase in sales, while Sony Corp. (#6) managed a 29% increase in electronics revenue. Canon Inc. (#9), Pioneer Electronic Corp. (#14), and TEAC Corp. (#46) all saw revenue growth of 20% or more. Overseas sales account for more than half of total revenue for all these companies.

The weaker yen gave a big boost to exporters, as each dollar earned converted to 20% more yen than last year. But the technological innovation required for survival in the high-yen years also means the Japanese producers have the advanced products free-spending U.S. and European consumers want. Sony, for example, increased sales by 46% in the United States and 44% in Europe—more than twice its 19% gain in Japan—thanks to strong demand for its ever-smaller camcorders and ever-larger television screens.

Only two companies managed more than 20% growth without major exports or consumer products. Tokyo Electron Ltd. (#36) increased sales 38%, and Omron Corp. (#16) achieved 23% sales growth. Both companies prospered from strong capital investment in Japan, as semiconductor makers started buying next-generation production equipment and other producers stepped up their factory automation. Sales of semiconductor-production equipment contributed 65% of Tokyo Electron revenue for the year, up from 59% last year and 48% the year before. Besides doing well in its core factory-automation market, Omron saw healthy growth in products from low-frequency massage equipment to engineering workstations.

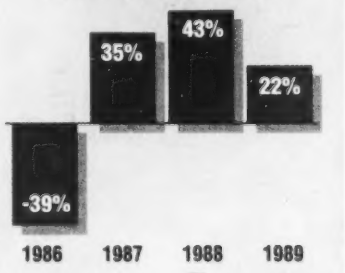
Steady sales growth...

percentage change in electronics revenues of top 20 Japanese electronics companies, in yen



...but slower profit growth

net income growth at top 20 Japanese electronics companies, in yen



Source: ELECTRONIC BUSINESS

Some big names significantly lagged behind the rest of the industry. Total revenue growth at Kyocera Corp. (#18), once the model Japanese entrepreneurial growth company, was up only 8% last year in total revenue, as improved plastic-packaging technology eroded its ceramic-packaging franchise. And Nippon Telegraph and Telephone Corp. (#7) is finding life much harder after deregulation, growing a meager 3%.

Likewise, Fujitsu Ltd. (#5) saw only 7% electronics revenue growth, as it continued to flounder in the fast-growing personal-computer sector. Matsushita Electric Industrial Co. (#1) grew only slightly faster in electronics at 8%.

Measured in yen, growth at Japanese electronics companies remains steady. Available data for the top 20 Japanese electronics companies indicate electronics revenue in yen grew by 13% in the fiscal year ending March 31 after 13% and 10% increases the previous two years respectively. This compares favorably with the meager 6% revenue growth in dollar terms by the top 20 U.S. electronics companies in the past calendar year and 11% in 1988.

However, sales per employee—an approximation of productivity—rose

Japanese vs. U.S. electronics companies in 1989

	Japanese Top 20	U.S. Top 20
Electronics revenue	$186.8 (+13%)	$196.48 (+6%)
Total revenue	283.2 (+14%)	216.8 (+5%)
Net income	9.4 (+22%)	11.7 (+17%)
Net income/sales	3.3%	5.4%
Revenue/employee	$164,400 (+2%)	$127,000 (+10%)
Net income/employee	5,400 (+3%)	6,800 (+23%)

Japanese figures for fiscal year ending March 1990
Exchange rate: 158 yen=$1

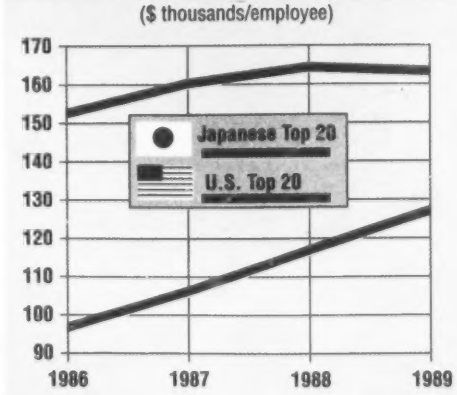
only slightly in fiscal 1989. The top 20 Japanese electronics companies posted a 2% productivity increase for the fiscal year ending March 31. Thanks to streamlining, the top 20 U.S. electronics companies reported an average productivity improvement of 8.9% in their most recent fiscal-year reports.

Since ELECTRONIC BUSINESS started tracking sales per employee in 1986, the top 20 U.S. companies have consistently improved this figure at a faster rate than the top 20 Japanese companies, though the Japanese figure is still higher. Significant gains in the past two years have brought U.S. sales per employee up to $127,000, nearly 80% of the Japanese productivity levels of $164,400 in sales per employee. Structural differences account for some of the 20% gap: Workers at some Japanese affiliate companies help make products but aren't included in consolidated employee totals.

But a major reason for improved U.S. productivity figures last year was not sales growth but employment cutbacks. The leading 20 U.S. companies trimmed their work force by about 5% to 1.7 million. Meanwhile, their Japanese counterparts *increased* employment by about 10% to 1.7 million.

Many of these new Japanese electronics employees work outside Japan. Producers continued to move production of lower-value-added products to low-cost Asian countries. The more producers move to Asia, the more suppliers flock to follow. Also, the major Japanese electronics companies' continued big buildups in Europe, so as not to be shut out of the unified European market in 1992. And they continued to expand in the United States, building capabilities in their major market and hoping to ease trade friction. The companies are finding that the new foreign hires aren't producing as efficiently as the more experienced Japanese work force. Complex global networks may always take more people to run than the old plants churning out exports.

Japan leads U.S. in productivity



Exchange rate: 158 yen=$1 Source: ELECTRONIC BUSINESS

Some of the big U.S. productivity gains in recent years came from starting to do things the Japanese did first—from simplifying manufacturing design to introducing just-in-time delivery. The Japanese are now tinkering with incremental improvements. Indeed, much attention in Japan has shifted away from churning out more widgets more efficiently, focusing instead on the strategy of increasing value-added functions, relying on technological innovation to make more sophisticated products that competitors can't match.

Profits up

On the whole, earnings at the Japanese electronics makers continued to improve, though not quite so dramatically as in the past few years. This year saw a 22% increase in net income. That follows two years of 35% to 40% growth, which brought operating margins back up to the levels of pre-1985 days, before the high yen. Margins averaged close to 8% of sales, up from about 7% for last year's top 20.

Practically none of the industry leaders managed to exceed these single-digit averages, most running operating margins of 6% to 8%. An exception was Sony, again making good in the consumer electronics business with a 10.3% operating margin.

A surprising assortment of companies below the top 20 posted a respectable performance last year. Doing markedly better than the rest of the electronics sector were Nintendo, with a fat operating margin of 26.7%; Nikon Corp., with 15.5%; Minebea Co., with 14.7%; Murata Manufacturing Co., with 14.4%; and Kyocera, with 14.3%. □

ELECTRONIC BUSINESS uses financial reports, news releases, and discussions with industry officials to track the financial performance of the leading Japanese electronics companies before the companies' annual reports are available in English. Japanese regulations have changed to require earlier reporting of consolidated results, and many Japanese companies have increased in international sophistication. These factors enabled ELECTRONIC BUSINESS to expand the list this year to 50 companies.

Top Japanese electronics companies

Rank	Company	Electronics revenues ($ millions)	Percentage change 89/88	Total revenues ($ millions)	Percentage change 89/88	Operating income ($ millions)	Percentage change 89/88
1	Matsushita	$27,300	8%	$37,992	9%	$2,865	9%
2	NEC	21,799	12%	21,799	12%	1,477	26%
3	Toshiba	19,100	13%	26,911	12%	2,000	27%
4	Hitachi	17,900	11%	44,797	11%	3,172	16%
5	Fujitsu [1]	16,138	7%	16,138	7%	1,092	4%
6	Sony	14,760	29%	18,227	34%	1,868	84%
7	NTT [1]	13,800	3%	38,114	3%	5,063	-2%
8	Mitsubishi Electric	9,400	NM	18,838	10%	1,440	45%
9	Canon	8,400	22%	8,550	22%	734	32%
10	Sharp [1]	7,100	10%	8,658	10%	485	43%
11	Sanyo	4,428	7%	8,643	10%	287	203%
12	Ricoh	4,400	12%	5,288	15%	179	-18%
13	Oki [1]	3,987	13%	3,987	13%	223	-2%
14	Pioneer	3,239	27%	3,239	22%	NA	NA
15	TDK	3,024	14%	3,024	NA	353	NA
16	Omron	2,903	23%	2,903	23%	NA	NA
17	Alps [1]	2,549	13%	2,549	7%	73	23%
18	Kyocera	2,231	21%	2,665	8%	380	-3%
19	Nippondenso [1]	2,203	20%	8,248	11%	610	10%
20	Seiko [1,3]	2,200	NA	2,670	6%	NA	NA
21	Casio [1]	1,929	13%	1,929	13%	109	52%
22	Nintendo [1,4]	1,843	43%	1,843	43%	493	61%
23	Citizen [1]	1,800	8%	2,117	11%	152	19%
24	Minolta [1,2]	1,700	NA	2,200	11%	170	NA
25	Murata	1,568	2%	1,568	2%	226	-18%
26	Yokogawa [1]	1,500	NA	1,524	NA	80	NA
27	Matsushita Electric Works [1]	1,500	NA	5,644	13%	446	11%
28	Nikon [1]	1,400	NA	1,800	12%	278	23%
29	Ryosan [1]	1,317	12%	1,317	12%	17	2%
30	Japan Radio [1]	1,212	15%	1,212	15%	106	23%
31	Fanuc [1,2]	1,200	20%	1,200	20%	NA	NA
32	Kenwood [1]	1,178	18%	1,178	18%	51	9%
33	Shimadzu [1]	1,100	6%	1,137	6%	95	5%
34	Yamaha [1]	1,100	NA	3,157	2%	120	30%
35	Olympus	1,100	NA	1,387	14%	105	11%
36	TEL [1]	1,096	38%	1,096	38%	121	98%
37	Rohm [1,2]	1,000	10%	1,000	10%	NA	NA
38	Clarion [1]	960	7%	1,007	7%	19	251%
39	Shin-Etsu Chemical [1,2]	940	NA	2,600	2%	NA	NA
40	Mitsumi [1]	889	7%	889	7%	18	1092%
41	Sanshin Electronics [1]	871	16%	871	16%	13	114%
42	Sumitomo Bakelite [1,2]	780	NA	1,100	NA	NA	NA
43	Ryoyo Electro [1]	766	14%	766	14%	40	18%
44	Kokusai [1,2]	710	9%	710	9%	NA	NA
45	Sanken Electric [1,2]	680	10%	680	10%	NA	NA
46	Teac [1]	652	20%	652	20%	NA	NA
47	Anritsu [1]	626	6%	626	6%	73	-3%
48	Nippon Chemicon [1]	618	7%	618	7%	NA	NA
49	Fujitsu General [1,2]	590	NA	1,000	15%	NA	NA
50	Minebea [1]	580	NA	1,451	15%	213	21%

NA = Not available. NM = Not meaningful
Listing uses an exchange rate of 158 Yen to $1, the rate used by companies whose fiscal year ends March 31. Companies whose fiscal years end at other times use different rates in their own reporting.

1 Consolidation by Japanese accounting conventions which differ slightly from U.S. Securities and Exchange Commission rules.

2 Preliminary figures before release of final consolidated results.

3 Sales of Seiko Corp. (formerly Hattori Seiko) only. Does not include sales.

Operating income as a percentage of revenues	Net income ($ millions)	Percentage change 89/88	Net income as a percentage of revenues	Revenue per employee	Net income per employee	Fiscal year ended
7.5%	$1,491	10%	3.9%	$191,591	$7,518	3/90
6.8%	539	32%	2.5%	190,216	4,707	3/90
7.4%	834	10%	3.1%	189,515	5,873	3/90
7.1%	1,335	14%	3.0%	154,471	4,604	3/90
6.8%	549	24%	3.4%	140,329	4,775	3/90
10.3%	651	42%	3.6%	190,658	6,806	3/90
13.3%	1,652	-1%	4.3%	139,661	6,053	3/90
7.6%	486	44%	2.6%	211,396	5,454	3/90
8.6%	242	3%	2.8%	192,566	5,458	12/89
5.6%	264	43%	3.0%	141,235	4,308	3/90
3.3%	107	175%	1.2%	155,658	1,920	11/89
3.4%	100	-11%	1.9%	142,912	2,715	3/90
5.6%	104	7%	2.6%	206,247	5,359	3/90
NA	186	49%	5.8%	233,028	13,414	3/90
11.7%	147	NA	4.9%	116,325	5,645	3/90
NA	148	23%	5.1%	192,949	9,822	3/90
2.8%	5	-87%	0.2%	76,631	135	3/90
14.3%	214	2%	8.0%	88,825	7,136	3/90
7.4%	306	24%	3.7%	166,990	6,197	3/90
NA	12	NM	0.5%	166,844	767	12/89
5.7%	48	13%	2.5%	400,847	9,877	3/90
26.7%	217	14%	11.8%	NA	NA	8/89
7.2%	61	15%	2.9%	126,944	3,676	3/90
7.7%	24	NA	1.1%	199,901	2,179	3/90
14.4%	121	-12%	7.7%	74,676	5,746	3/90
5.2%	67	NA	4.4%	NA	NA	3/90
7.9%	201	32%	3.6%	NA	NA	11/89
15.5%	119	63%	6.6%	NA	NA	3/90
1.3%	20	-3%	1.5%	877,764	13,599	9/89
8.7%	37	18%	3.1%	346,383	10,700	3/90
7.7%	24	NA	1.1%	NA	NA	3/90
4.3%	26	231%	2.2%	346,430	7,645	3/90
8.4%	46	4%	4.1%	270,671	10,972	11/89
3.8%	39	67%	1.2%	NA	NA	3/90
7.6%	53	25%	3.8%	NA	NA	3/90
11.1%	57	62%	5.2%	548,225	28,614	9/89
NA	NA	NA	NA	NA	NA	3/90
1.9%	4	-40%	0.4%	NA	NA	9/89
NA	NA	NA	NA	NA	NA	3/90
2.0%	-2	NM	-0.3%	49,396	-127	1/90
1.5%	10	93%	1.1%	1,088,956	12,049	9/89
NA	NA	NA	NA	NA	NA	3/90
5.2%	18	12%	2.4%	1,168,175	27,757	1/90
NA	NA	NA	NA	NA	NA	3/90
NA	NA	NA	NA	NA	NA	3/90
NA	NA	NA	NA	NA	NA	3/90
11.6%	38	2%	6.0%	208,770	12,612	3/90
NA	NA	NA	NA	NA	NA	3/90
NA	NA	NA	NA	NA	NA	3/90
14.7%	36	-22%	2.5%	55,810	1,399	9/89

of affiliates Seiko Epson and Seiko Instruments, which are separate privately held corporations. Seiko Epson sold an additional $700 million (approximately) of electronic equipment through its own subsidiary Epson Sales; much of the rest of the approximate $3 billion was sold to Seiko Corp.

4: Nintendo revenues for the seven months of its new fiscal year ending March 1990 were $1520 million; operating income $412 million; net income $208 million.

Source: ELECTRONIC BUSINESS

PERSONAL COMPUTERS

Asian PC makers to boost R&D budgets

HONG KONG—RESEARCH and development is alive and growing in Asia's personal computer industry. Results from a recent ELECTRONIC BUSINESS ASIA survey of 14 Asian-owned PC makers in Hong Kong, South Korea, Singapore, and Taiwan indicate that most respondents plan to increase their spending on R&D during the next few years.

Taiwanese PC makers have the most aggressive growth plans, with spending on R&D programs expected to climb from an average of 3.6% of revenue in 1989 to 14% this year and 15.5% by 1992. South Korean vendors, with the highest R&D rates averaging 6% today, plan more modest growth to 7% this year and 9% in 1992. Two-thirds of the Taiwanese respondents and 80% of those from South Korea considered R&D extremely important to their success.

Singapore's PC companies, although starting from a relatively low average spending level of 2% in 1989, plan to increase R&D spending to 3.5% of revenue in 1989 and to 6.5% by 1992. Unlike their Taiwanese and South Korean counterparts, only one-third of the respondents in Singapore indicated R&D was extremely important to the success of their company. One reason for this attitude is that Singaporean respondents depend on alliances and partnerships, many with locally based multinational corporations.

Hong Kong PC makers, looking ahead nervously to the 1997 takeover by the mainland government, projected the most modest plans for R&D spending growth. Hong Kong makers devoted an average of 3.5% of revenue to R&D in 1989 and projected only modest increases to 4% this year and 4.5% by 1992.

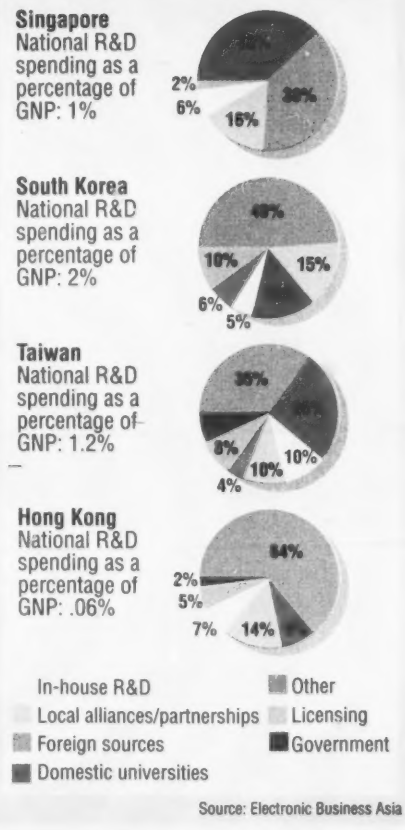
Eighty-five percent of the respondents believe government-supported research programs are necessary for the success of their industry, yet few of them appear to be involved in such programs. None of the companies from Hong Kong or Singapore reported participation in a government-funded research program, while only one-third of the Taiwanese companies and 60% of the South Korean companies are currently involved in government research.

The level of participation appears to be higher for research consortia. All of the Taiwanese companies reported involvement in some kind of research consortium, as did 80% of South Korean companies and 33% of the Singaporeans. None of the Hong Kong companies said they participated in a research consortium, probably because few, if any, such programs exist in the colony.

Most PC companies responding to the survey spent a lower percentage of their revenue on R&D compared with their counterparts in the U.S., where an average of about 9% of revenue is spent on R&D, or in Japan where the level is about 6%.

ANN MARIE ANGEBRANDT

Sources of R&D funding



Source: Electronic Business Asia

SUPERCOMPUTERS

Fujitsu pushes ahead in large-system Unix

TOKYO—FUJITSU Ltd. recently announced the world's first mainframe and supercomputer operating system that conforms to Unix International's System V Release 4, for delivery in April 1991. The company expects to market 850 systems—350 overseas and 500 in Japan—at a rental price starting at $1,550 per month.

Although Fujitsu is targeting its home market, the Unix operating system is more important overseas. Fujitsu estimates that 50% of overseas supercomputer purchasers will opt for the new Unix operating system, which the company calls UXP/M for Unix products for mainframes. In Japan, the ratio of supercomputers with Unix operating systems will initially be about 10%.

In the next three years Fujitsu intends to increase the number of engineering applications to 300 and commercial applications to 200—including those ported at centers in the United States, Australia, Spain, and Germany. UXP/M supports multiprocessing on mainframes for improved performance. It also supports high-speed networking, including the FSLINK high-speed local area network and Ultranet 1000, developed by Ultranetwork Technologies for data transfer at rates up to one gigabit per second.

Meanwhile, IBM and Hitachi Ltd. have reached a basic understanding for their Japanese subsidiary, IBM Japan Ltd., to cooperate in the development and porting of Unix software that can be used on both companies' mainframes. Both are members of the open software foundation, which IBM helped set up in order to popularize its version of Unix.

CHARLIE COHEN

Smart power revs up for the auto market

Smart-power IC makers are betting the growing automotive electronics market will finally jump-start their business

BY GIUSEPPE LABIANCA

After years of looking for high-growth applications, smart-power IC makers may have finally found their promised land of fast growth and high volume—automotive electronics. Those producers that can sell to that market will be in a good position to participate in the long-awaited smart-power boom.

Smart-power ICs—which merge logic, control, and power functions onto a single chip—allow for fault detection while taking up less space because of their high level of integration. BIS/Mackintosh, a London-based market research firm, estimates the total worldwide smart-power market at $660 million this year, up from $581 million in 1989 and $419 million in 1988.

Earlier forecasts expected smart power to have grown into a multibillion-dollar market by now. Instead, although growth is solid, the worldwide market has matured much more slowly because the chips are just too expensive when compared with the discrete components they are intended to replace.

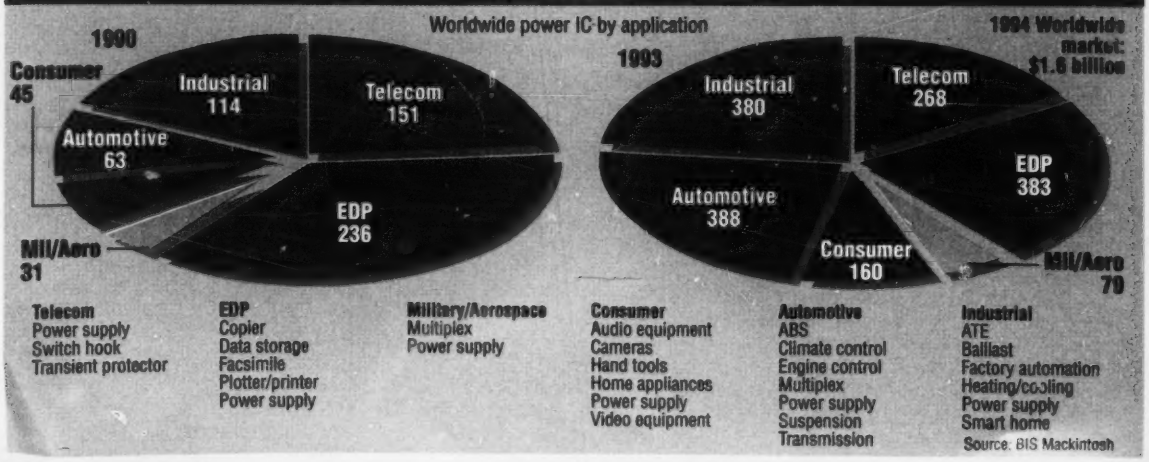
The relative system cost of power ICs has dropped significantly over the last few years but still runs about 50% higher than for a system using discrete components, according to Steve Hanke, marketing manager for smart-power products at Texas Instruments Inc.'s semiconductor group in Dallas. Hanke feels that once the cost-effectiveness problem is overcome, the smart-power explosion will finally occur. He also adds, however, that the crossover point will not be reached until the 1994-1995 time frame.

What has kept costs high is the lack of a major high-volume market which would help develop standard product lines. Smart-power ICs are unlike microcontrollers, for instance, which, introduced at a relatively high price in the automotive industry, are then driven down in cost by being used in high volume. Cost has not allowed smart power to penetrate other markets that normally use cheaper standard IC products derived from the automotive industry. Much of the inability to come up with standard smart-power products comes from the fact that these products are very application-specific.

"What makes the smart-power market so difficult is that no one single technology is best for everybody because there are so many processes and interconnect combinations," says Ian Wilson, product marketing manager for power products in the Phoenix, Ariz.-based U.S. headquarters of SGS-Thomson, the world's largest smart-power producer.

Despite many advantages over the use of discrete components, smart power has not penetrated the automotive market or established a

Smart-power makers will target the auto market



library of standard products. Bernd Leinwetter, group product marketing manager for Siemens AG in Santa Clara, Calif., believes that part of the problem has been that U.S. automotive electronics companies—particularly Delco Electronics Corp., General Motor's captive components supplier—have been very conservative in their move to smart power.

Bob Brockman, Delco's purchasing agent in its Kokomo, Ind. headquarters, agrees the smart-power market may have been slowed by the shortcomings of customers, including Delco. "We may not have been clever enough in defining applications that exploit the capabilities of smart power," says Brockman. But he adds that smart-power makers were developing high-voltage "blockbusters" that Delco didn't need for most applications.

The smart-power makers are working more closely with the automotive industry and now understand their needs better than before. Many companies are turning to an application-specific approach to smart power in an effort to keep costs down.

The breakthrough

With automotive electronics projected to grow at a 19% annual rate over the next five years, according to The Freedonia Group, a Cleveland-based market research firm, smart-power IC makers feel that they are finally about to make their big breakthrough into the automotive market. Analysts agree. Based mostly on the growth from the automotive industry, Gary Grandbois, smart-power analyst with market researcher Dataquest, believes the smart-power market will grow 20% annually over the next five years. BIS/Mackintosh projects automotive sales of smart-power chips worldwide will total $338 million in 1993, up from $63 million this year.

The automotive electronics manufacturers may have reached a point where they can no longer increase the number of electromechanical relays in the automobile. With such critical systems as anti-lock braking (ABS) being introduced, reliability is critical. Smart power as a diagnostic tool can tell the microcontroller if there is about to be a short in the electrical system. The microcontroller then can shut down a non-essential system like the defogger, while it keeps ABS up and running.

Smart power's real-time feedback circuits make it useful in automotive applications such as ABS, advanced transmissions, advanced suspension systems, and multiplexing—all of which are forecast to be used extensively over the next few years. Brockman says Delco will begin using the smart-power ICs it co-developed with Motorola Inc. in its anti-lock braking system, ABS-VI, which will debut on GM's 1993 model-year autos.

The largest smart-power IC makers cite the automotive market as their target over the next few years. Dataquest's Grandbois believes that because smart power's future is integrally linked to the automotive electronics market, it will spell victory for the largest semiconductor makers. According to Grandbois, there are two forces within the automotive market which give the bigger companies like Texas Instruments and Motorola the advantage:

- There are relatively few automotive electronics makers in the world, and they have trimmed their IC supplier lists. The auto electronics makers prefer to work with only the very largest suppliers, which they can be sure will have the resources to continue supplying them with increasingly complex ICs over many years;
- The supplier must have a great deal of process capability because different applications in a car require various combinations of processes that a small company can't afford to compete with.

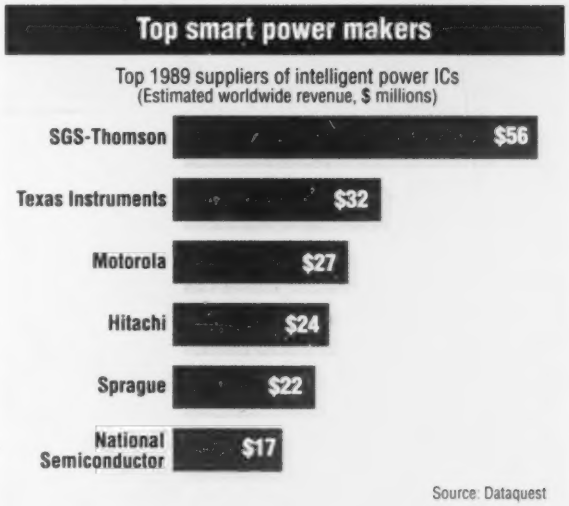
New entrants, albeit large ones, continue to pour into the smart-power market in the hope that the boom will soon begin. Among them are Siemens AG, Harris Semiconductor, and a joint effort by National Semiconductor Corp. and International Rectifier Corp.

Analysts believe that once the high volumes in the automotive market help smart-power ICs achieve cost-competitiveness with discrete components, competitors will make inroads into other market segments.

Currently, electronic data processing, which includes hard disk drives and high-end printers, is the largest user of smart-power products, according to BIS/Mackintosh, and it is forecast to grow steadily over the next three years. Smart-power ICs are being used extensively as motion controllers in so-called "intelligent" hard disk drives. As these drives move toward smaller form factors, like 3.5 and 2.5 inch, the need for integration becomes greater and greater.

The market for hard disk drives is also very tough to compete in because of the severe time pressures. Unlike the automotive market, where the design cycle takes at least three years and product life-cycle is high, the product life-cycle of hard disk drives is only a few months. There is no room for mistakes or time overruns.

Many executives caution that it will be difficult to penetrate some of these other markets such as industrial control, which is the third-largest segment for smart power. "The smart-power market is a dice roll for companies," according to Grandbois. "There are companies out there that are still betting this market will someday become huge, and they are making the enormous investments necessary to get a piece of the market in the future." □



High demand, low price brighten flash-memory market

As customers upgrade from EPROMs, more companies challenge Intel's dominance by introducing their own flash-memory products

BY TERI SPRACKLAND

For most of the past decade flash memory technology has been waiting in the wings for an opportunity to star. Now, at long last, that moment may have arrived.

More flash chips, which can be both programmed and easily erased, are being introduced for a growing number of new applications. More players are entering the market, which is, nevertheless, still heavily dominated by its leader, Intel Corp. of Santa Clara, Calif. Perhaps most significantly of all, prices for these products have been tumbling, prompting users to upgrade to flash chips from erasable programmable read-only memory chips (EPROMs).

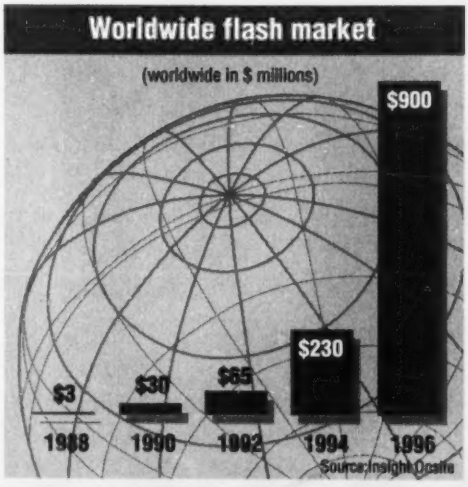
Flash memories appear to finally be carving out a significant niche between the high-volume EPROMs and the fully featured, but high-cost, electrically erasable chips (EEPROMs). By 1996 the worldwide flash market will have averaged 76% growth a year to $900 million, predicts Will Booth, president of market research firm Insight Onsite in Scottsdale, Ariz. Major targeted markets for flash memory chips include embedded control, automotive control, and factory automation and telecommunications applications.

Flash chips got their name because they are programmed and erased with a flash of light, rather than with ultraviolet exposure used to program EPROMs, which requires a special facility. Like the vastly more expensive EEPROMs, flash chips allow designers and other users to easily erase and reprogram, even remotely. They can also be used in radioactive environments, an important consideration in military applications. All three programmable technologies are nonvolatile—unlike static and dynamic RAM—meaning they retain information even after power is turned off.

Problems remain

Many of the technical and cost questions that plagued flash technology during its early development are now being resolved, yet certain barriers to commercial success must still be removed. How many times flash products can be erased and reprogrammed remains unclear, with suppliers making various claims. Also unresolved is the question of specifications, which differ significantly among vendors. As a result, users are left with only the most rudimentary standards.

Another issue is power consumption. Flash memories come in two flavors: 12 volt and 5 volt. Chips that need 12 volts require a second power supply, which takes up valuable board space and is noisier. While easier to design with, on-chip 5-volt generation is expensive because the chip's die size must be bigger. Due to the 5-volt chip's higher cost and somewhat more limited availability, users seem content to buy 12-volt versions at this stage.



The most developed portion of the flash market today is for those applications that replace EPROMs. About $2 million of the $8 million in total EPROM-replacement flash sales in 1989 was in this segment, according to Booth. By 1992 this segment will top $29 million, he projects. And by 1996 growth for this segment will displace 19% of the existing $350 million EPROM worldwide market. In particular, the 1-megabit-density flash chip is likely to displace EPROM sales, observers say. Generally speaking, flash densities are about one density-generation behind EPROMs.

Users must not only decide whether their applications justify the extra expense of being reprogrammable, they must also accurately predict how often an application is likely to be reprogrammed. Embedded systems that may need an occasional software upgrade will put far fewer read-write demands on a chip than replacing disk drives for portable applications.

For simpler applications, the number of rewrite cycles a chip can perform is not crucial, since upgrades would occur only occasionally. Flash chips can be erased anywhere from a dozen to thousands of times, according to manufacturers' claims. The ability to perform those upgrades—however rarely they may be necessary—is a significant motiva-

The flash market players

Intel Corp. has so successfully transferred its strength in EPROMs to flash memory products that it has an almost absolute hold on the market. Will Booth, president of market research firm Insight Onsite in Scottsdale, Ariz., puts Intel's market share at 90%. Walt Lahti, vice president of In-Stat Services, another Scottsdale market-research firm, more conservatively estimates 80%.

Still, there is growing competition in the market. Two notable players, both in San Jose, are Atmel Corp., which calls its flash products PEROMs, and Seeq Technology, which pioneered the technology.

Seeq suffered a serious setback when manufacturing partner National Semiconductor pulled out of further development in 1989. Then Seeq signed Philips Components-Signetics as a foundry with an option to market the products. After recording a loss of $4.68 million for the fiscal quarter ended June 30, however, Seeq announced it would terminate mass production of chips in San Jose, lay off 95 employees, and convert the San Jose manufacturing plant so it would be used strictly as a research-and-development facility by March of next year.

Despite Intel's formidable lead, numerous other companies are demanding entry to the marketplace. Catalyst Semiconductor Inc. in Santa Clara, for example, has leaped onto the scene with a product that is software compatible with Intel products, thus aiding the market's need for standardization, according to marketing vice president Krish Panu.

Promising products are coming on board from both Texas Instruments Inc. of Dallas and Japan's Toshiba Corp., market researcher Booth says. At least four more EPROM manufacturers—Advanced Micro Devices Inc. (AMD) in Sunnyvale, Calif.; SGS/Thomson Microelectronics Inc. in Carrollton, Texas; and Japanese giants Hitachi Ltd. and Mitsubishi Corp.—are expected to enter the market this year. AMD executives confirm that their product line will be compatible with Intel's, further strengthening the market.

Other contenders are Exel Microelectronics of San Jose; Micro-Chip Technology Inc. of Chandler, Ariz.; Japan's Fujitsu Ltd.; and South Korea's Samsung Electric Co. Ltd. □

tion for users to switch from EPROMs to flash chips. The cost of one on-site technician's visit can be much higher than the savings generated by selecting less expensive EPROMs that must be replaced rather than reprogrammed.

Solid-state disk memory

A major opportunity for flash chips will be as a solid-state memory chip, replacing more fragile disk drives in portable applications. Initial growth will be slow here, with a market of only about $9 million developing by 1992, according to Booth. By 1994, however, flash production costs will drop to the point that competitive pricing against low-capacity disk drives will be possible. Booth expects the market will explode to $360 million by 1996—a 200% annual growth rate. Intel's Richard Pashley, memory components division general manager, says this application may have the greatest potential of all for significant growth.

For these applications, the number of rewrite cycles a chip can execute is paramount. Repeated saving of information to the chip will require far more read-write cycles in a disk replacement application than in other uses.

Also for top-of-the-line applications, such as expensive laptop or pocket computers, the flash chip may solve the thorny problem of bulky and fragile disk drives. As their prices continue to fall, solid-state flash chips are expected to become a major factor in the mass memory market. Access time, which on disk drives is now measured in milliseconds, could be measured in nanoseconds with solid-state memory.

One challenge to flash chips could be other varieties of nonvolatile memory which are now under development. For example, Ramtron Corp. in Colorado Springs is working on nonvolatile ferroelectric RAM. Flash technology might take the spotlight, only to find itself quickly supplanted by a younger, more attractive technology.

By 1994 flash production costs will be competitive with low-capacity disk drives

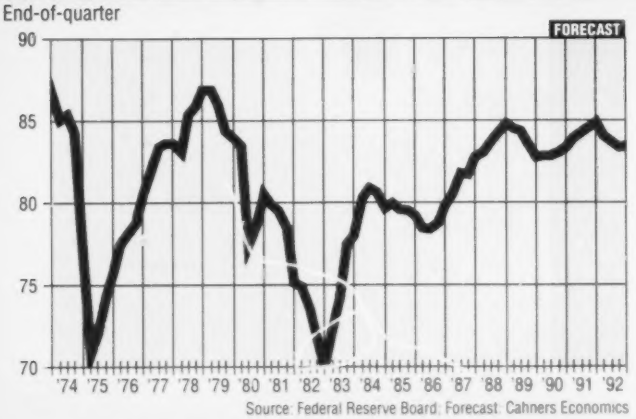
Battery-backed RAM

About half of the 1989 flash market was for products that replaced battery-backed SRAMs and DRAMs, according to Booth. He forecasts $190 million in revenue by 1996, for an annual growth rate of 170%. Such applications would increase the battery life of products such as PCs, solid-state data recorders, and main memory in hand-held computers and instruments.

A small factor contributing to the size of the flash market will be the users who step down from fully featured EEPROMs to the substantially less expensive flash chips, according to Catalyst's Panu, who was formerly with EEPROM leader Xicor Inc. in Milpitas, Calif. EEPROMs have been used widely in military applications, such as jet fighters and missile guidance systems, since EEPROMs, unlike EPROMs, can hold up to radioactive environments. Flash chips, which also withstand radiation, cost only one-tenth to one-twentieth as much as EEPROMs, Panu estimates.

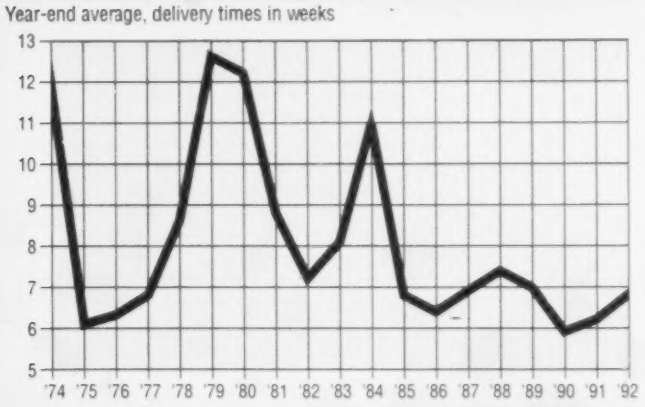
Prices are falling rapidly for flash chips, according to analysts. At the beginning of this year flash chips cost two and one-half times as much as EPROMs and are expected to drop to just two times as much by the end of the year. As prices drop and new applications become increasingly popular, the flash chip may finally prove that it is much more than a flash in the technological pan. □

Total manufacturing operating rate



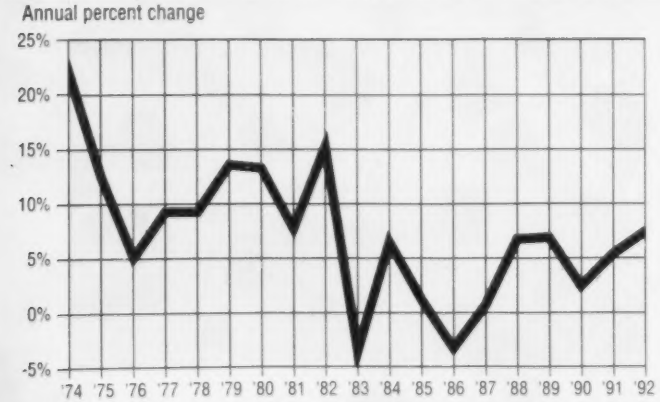
Source: Federal Reserve Board; Forecast: Cahners Economics

Electronic component leadtimes



Source: Electronics Purchasing; Forecast: Cahners Economics

Total manufacturing inventories



Source: U.S. Commerce Dept.; Forecast: Cahners Economics

Buying conditions healthy despite oil price rise

Supply conditions continue to favor buyers at this late stage in the business cycle, with both businesses and consumers hoping for an economic upturn in 1991. While it may seem overly optimistic to call for an expansion after the recent turbulence in oil markets, a close look at the economy shows why a recession remains unlikely.

In general terms, lead times are a reliable indicator of supply pressures in the economy. Just before the oil shocks of 1973-1974 and 1979-1980, lead times were already long. Manufacturers were operating near capacity, and suppliers were struggling to meet the demand. Double ordering was a common practice, and inventories swelled. When oil prices soared, strong demand made it easy for manufacturers to pass on costs, thus boosting inflation to double-digit levels.

The scenario today is different, especially when it comes to the electronics industry. Third-quarter data for electronic component lead times now stand nearly 41% below the third-quarter level in 1979, reflecting easy buying conditions for electronic components. Careful inventory control has helped keep inventories in line with demand, reducing the need for double ordering. Since demand is much weaker than during the previous oil shocks, expect lead times to stay short. Cahners Economics expects delivery times for electronic components to average 5.8 weeks this year, down 16% from the prior year. However, as the economy picks up speed in 1991, expect lead times to average 6.2 weeks, 5% above the 1990 level, and stretch to 7 weeks by the end of 1992.

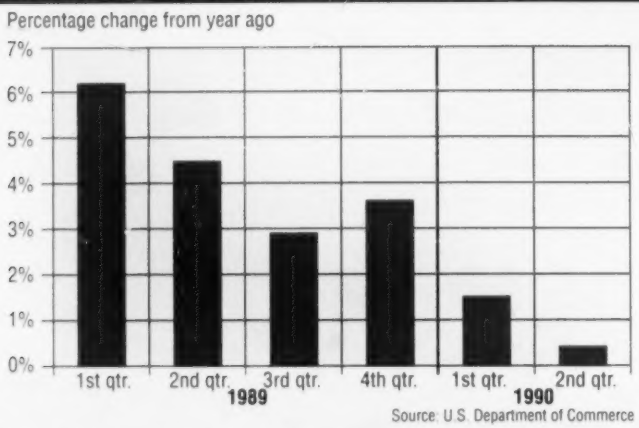
Active component lead times are expected to average 6.7 weeks in 1990, down nearly 1.5 weeks from the 1989 average. Faster lead times for memory devices this year contributed significantly to the overall decline in delivery times for active devices.

Lead times for passive components are often less volatile than active component lead times. After averaging six weeks in 1989, Cahners Economics expects delivery times for passive components to average around five weeks this year and in 1991.

JULIE HANDELMAN

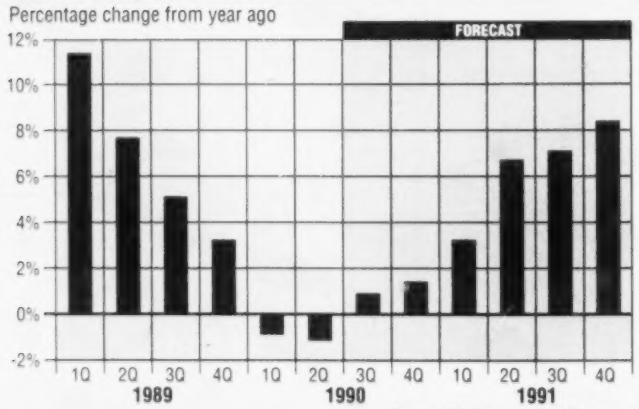
For more information on Cahners Economics' forecasting services, including seminars, newsletters, and database diskettes, contact Dan Buchan at (617) 630-2105; by fax at (617) 630-2100; or write Cahners Economics, Cahners Publishing Co., 275 Washington St., Newton, MA 02158

Backlog growth tapers off in early 1990...



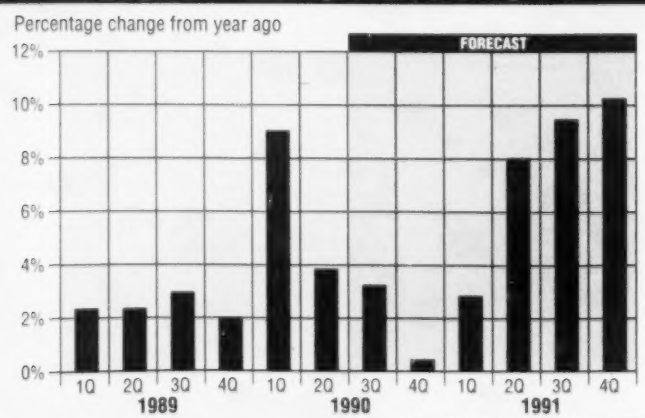
Source: U.S. Department of Commerce

...and inventories slow, then turn the corner...



Source: U.S. Department of Commerce

...bringing slow orders growth, then upturn



Source: U.S. Department of Commerce

Instruments and controls growth rate keeps sliding

Production growth of instruments and controls continued to decrease during the second quarter of 1990 compared with the same period in 1989. Cahners Economics believes production growth bottomed out in the third quarter and will rebound for at least the next five quarters.

The current downward trend began in the third quarter of 1988 when output peaked at 12.2% above the previous year. The year-ago quarterly gain now stands at 0.3% for the second quarter of 1990. Growth of unfilled orders declined during the second quarter of this year and now stands at 0.4% above last year's second quarter.

As sales increased 6.7% for the second quarter compared with a year ago, it is apparent that managers are opting to deplete their inventories rather than increase production. The buildup of inventory has slowed since the first quarter of 1989 and has actually decreased in the first two quarters of 1990. The second quarter shows inventory declined at a rate of 1.2% from the previous year. This trend may continue until it's clear which direction new orders are headed.

A rebound in the instruments industry will depend on new orders. The quarterly growth rate of new orders has slowed since its last peak of 13.9% in the fourth quarter of 1987 until it hit a low of 2% in the final period of 1989. The beginning of 1990 brought promising news as demand shot up 9% in the first quarter but in the second quarter of 1990 new orders grew by only 3.8%.

Where is demand headed now? The third quarter started off at a rate of 5.9%. If this rate holds, the recovery will occur ahead of Cahners's forecast which has orders slowing for the rest of 1990 before the expansion begins in 1991. Cahners forecasts an annual increase in orders next year of 7.6% and will continue upward in the following year. With backlogs and inventory at low levels, this increase in demand will translate directly into more production and sales in the upcoming year.

The ELECTRONIC BUSINESS Automatic Test Equipment Sales Index sank 4.8% in the second quarter of 1990 compared with a year ago. This sector will continue to experience negative growth in the third quarter and finish the year at negative 3.5% on an annual basis. However, the recent slowdown will place more emphasis on quality control, and as economic indicators stabilize, higher sales will appear in the fourth quarter with stronger gains ahead in 1991.

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